

# Exhibit Q

IW 1896188

# THE UNITED STATES OF AMERICA

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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

September 14, 2012

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OF:

APPLICATION NUMBER: 07/870,614

FILING DATE: April 16, 1992

PATENT NUMBER: 5,446,747

ISSUE DATE: August 29, 1995

By Authority of the  
Under Secretary of Commerce for Intellectual Property  
and Director of the United States Patent and Trademark Office



*N. Williams*  
N. WILLIAMS  
Certifying Officer

FT000001


**UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office**

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Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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07/870,614 04/16/92 BERROU

C 3784/20866

 EXAMINER  
DECADEY, A

B3M1/0208

 A. JAMES RICHARDSON  
LOCKE REYNOLDS BOYD & WEISELL  
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INDIANAPOLIS, IN 46204

ART UNIT PAPER NUMBER

2313

4

DATE MAILED: 02/08/94

 This is a communication from the examiner in charge of your application.  
COMMISSIONER OF PATENTS AND TRADEMARKS

☒ This application has been examined ☐ Responsive to communication filed on \_\_\_\_\_ ☐ This action is made final.

 A shortened statutory period for response to this action is set to expire 3 month(s), \_\_\_\_\_ days from the date of this letter.  
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

**Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:**

- |   |  |
|---|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited by Examiner, PTO-892. | 2. <input checked="" type="checkbox"/> Notice re Patent Drawing, PTO-948.        |
| 3. <input checked="" type="checkbox"/> Notice of Art Cited by Applicant, PTO-1449.      | 4. <input type="checkbox"/> Notice of Informal Patent Application, Form PTO-152. |
| 5. <input type="checkbox"/> Information on How to Effect Drawing Changes, PTO-1474.     | 6. <input type="checkbox"/> _____  |

**Part II SUMMARY OF ACTION**

 1. ☒ Claims 1-22 are pending in the application.

 Of the above, claims NONE are withdrawn from consideration.

 2. ☐ Claims \_\_\_\_\_ have been cancelled.

 3. ☐ Claims \_\_\_\_\_ are allowed.

 4. ☒ Claims 1-22 are rejected.

 5. ☐ Claims \_\_\_\_\_ are objected to.

 6. ☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.

 7. ☒ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.

 8. ☐ Formal drawings are required in response to this Office action.

 9. ☐ The corrected or substitute drawings have been received on \_\_\_\_\_. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable. ☐ not acceptable (see explanation or Notice re Patent Drawing, PTO-948).

 10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on \_\_\_\_\_, has (have) been ☐ approved by the examiner. ☐ disapproved by the examiner (see explanation).

 11. ☐ The proposed drawing correction, filed on \_\_\_\_\_, has been ☐ approved. ☐ disapproved (see explanation).

 12. ☒ Acknowledgment is made of the claim for priority under U.S.C. 119. The certified copy has ☒ been received ☐ not been received  
☐ been filed in parent application, serial no. \_\_\_\_\_; filed on \_\_\_\_\_

 13. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.

 14. ☐ Other

EXAMINER'S ACTION

Serial Number: 07/ 870,614

-2-

Art Unit: 2313

Part III DETAILED ACTION

*Drawings*

1. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.

*Claim Rejections - 35 USC § 112*

2. Claims 1-22 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

There is no antecedent basis for the inclusion of the following term(s):

- a) claim 1, line 1 'the error-correction coding...'  
further, line 5 'the temporal interleaving...'
- b) claim 2, line 1 'the systematic elimination...'
- c) claim 3, line 3 'the set of symbols...'
- d) claim 4, line 7 'the latency...'
- e) claim 6, line 1 'the increment...'
- f) claim 11, line 2 'the joint transmission...'

As per claim 5, (and columns ...), as inserted in parentheses does not have any patentable weight. The same is true for claims 6 and 7.

FT000198

Serial Number: 07/ 870,614

-3-

Art Unit: 2313

As per claim 8, line 10, the word 'pre-determine' should be change to 'predetermine'.

As per claim 10, the word 'neutral' is vague.

As per claim 13,  $(d_2 \times (X_1) - (X_2)) / d_2 - 1$ ; it is unclear if the small x in the numerator is denoting a multiplication or if x is a function of  $X_1$ . Use a dot (.) to denote the multiplication.

As per claim 16, 'said coefficient  $\beta$  is variable as a function of the ...' is grammatically incorrect.

As per claims 20-22, these claims are hybrid claims. claims 20-22 are directed toward an apparatus and cannot be dependent on claims directed toward method claims.

As per claim 22, 'comprising at least one module according to either claim 19, 2'. This claim is incomplete.

#### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this

FT000199

Serial Number: 07/ 870,614

-4-

Art Unit: 2313

section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

4. Claims 1-4, 18, 19 and 22 are rejected under 35 U.S.C. § 103 as being unpatentable over Betts et al. U.S. patent no. 4,677,626.

As per claims 1, 4 and 22, Betts et al. substantially teaches the claimed invention. here, the method comprises the steps of dividing the stream of input bits in groups. The encoding is done convolutionally. The method also has a step for interleaving the source data, see col. 4, line 39-49. further, the method uses a trellis decoder to decode the coded data. Not explicitly disclosed is that the method implements in parallel at least two independent step of coding.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Betts et al.'s method by incorporating parallel steps of convolutional coding to add redundant bits. This modification would have been obvious because a person of ordinary skill in the art would have been motivated by Betts et al.'s teachings of a trellis-coded modulation scheme with 8-state systematic encoder.

As per claim 2 and 3, Betts et al. teaches a switch to select among the coding steps, see col. 5, line 5- col.6, line 3 26.

FT000200



Serial Number: 07/ 870,614

-5-

Art Unit: 2313

As per claim 18, Betts et al. teaches the use of the viterbi algorithm to decode the coded data, see col. 4, line 5-10.

As per claim 19, Betts et al teaches a demultiplexing step, see col. 4, line 39-46.

5. Claims 5-7 are rejected under 35 U.S.C. § 103 as being unpatentable over Betts et al. as applied to claims 1-4, 18 and 22 above, and further in view of F.C. Piper et al " Optimal Interleaving Scheme For Convolutional Coding".

As per claims 5-7, Betts et al. substantially teaches the claimed temporal interleaving step as discussed above. Not explicitly disclosed is the interleaving matrix and how data is recorded and read therein.

Piper et al. in an analogous art teaches a technique for interleaving data to disperse the errors in a burst. here, data are recorded and transmitted row by row. Any two rows which may be affected by the same burst are transmitted as far apart as possible.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Betts et al.'s method by incorporating the step of interleaving said source data row by row. This modification would have been obvious because a person of ordinary skill in the art would be motivated to implement this optimal scheme for interleaving taught by Piper et al. which call for the transmission of data

FT000201

Serial Number: 07/ 870,614

-6-

Art Unit: 2313

row by row. moreover, Piper et al. suggest that this method leads to improved decoding performance.

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Albert Decady whose telephone number is (703) 305-9595.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-9600.

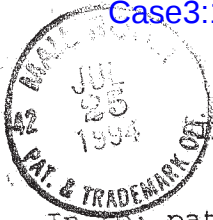
Albert Decady

February 1, 1994

  
ROBERT W. BEAUSOLIEL, JR.  
SUPERVISORY PATENT EXAMINER  
GROUP 2300

FT000202





IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: patent application of )

Claude Berrou )

ERROR-CORRECTION CODING METHOD )  
 WITH AT LEAST TWO SYSTEMATIC )  
 CONVOLUTIONAL CODINGS IN )  
 PARALLEL, CORRESPONDING ITERATIVE )  
 DECODING METHOD DECODING MODULE )  
 AND DECODER )

Serial No. 07/870,614 )

Filed: April 16, 1992 )

Our File No. 3784/20866 )

Examiner A. Decady

Group Art 2313

#5/A  
 RECEIVED  
 AUG 05 1994  
 GROUP 2200

2A  
 8/3/94

## Amendment and Reply Under 37 C.F.R. § 1.111

Hon. Commissioner of Patents  
 and Trademarks  
 U.S. PATENT & TRADEMARK OFFICE  
 Washington, D.C. 20231

Dear Sir:

In response to the outstanding Official Action of February 8, 1994, applicant, through its subscribing attorney, hereby requests a three (3) month extension of time for the filing of this response. The requisite fee for this extension of \$840.00 is enclosed. Please credit any overpayment of fees or charge any deficiency in fees to Deposit Account No. 12-1790.

Applicant, through its subscribing attorney, also makes the following changes to the specification and claims.

<del>090 BA 08/02/94 07870614</del>	<del>1 117</del>	<del>74.00 CK</del>
090 BA 08/02/94 07870614	1 117	840.00 CK

IN THE SPECIFICATION:

On page 9, line 21, replace "joint" with --contemporaneously

<del>090 BA 08/02/94 07870614</del>	<del>1 102</del>	<del>74.00 CK</del>
filed-- 090 BA 08/02/94 07870614	1 102	22.00 CK

FT000233

On page 9, line 22, after "application", insert --Serial Number 07/870,483--.

On page 9, line 25, replace "1992" with --1991, incorporated herein by reference--.

On page 15, line 22, replace "decoding" with --coding--.

On page 17, line 25, replace " $(ZX)_{p+1}$ " with -- $(Z)_{p+1}$ --.

On page 19, line 3, after "used" insert --by interleaver 12 of Figure 2--.

On page 19, line 17, replace "joint" with --contemporaneously filed--.

On page 19, line 18, after "application", insert --Serial Number 07/870,483--.

On page 19, line 21, replace "1992" with --1991, incorporated herein by reference--.

On page 20, line 20, after "11" insert --of Figure 2--.

On page 20, line 25, replace " $(d_2x(X_1) - (X_2)) / (d_2 - 1)$ " with -- $(d_2 \cdot (X_1) - (X_2)) / (d_2 - 1)$ --.

On page 20, line 28, replace " $g(X_2)_p, (X_3)_p$ " with -- $g((X_2)_p, (X_3)_p)$ --.

On page 20, line 29, after "matrix" insert --52--.

On page 21, line 10, replace "matrix 52" with --matrices 49 and 52--.

IN THE CLAIMS:

Applicant cancels claims 22 without prejudice or disclaimer of the subject matter thereof.

Applicant amends claims 1-13, 16, 17, and 20-21 by insertion of the underlined material and deletion of the bracketed material as follows:

1. (Amended) A method for [the] error-correction coding of source digital data elements, [wherein said method implements in parallel] comprising the steps of:

implementing at least two independent and parallel steps of systematic convolutional coding, each of said coding steps taking account of all of said source data elements[,] and providing parallel outputs of distinct series of coded data elements;

and [wherein said method comprises at least one step for the temporall] temporally interleaving [of] said source data elements[, modifying] to modify the order in which said source data elements are taken into account for [each] at least one of said coding steps.

2. (Amended) A method according to claim 1, comprising a step [for the systematic elimination] of systematically eliminating, at predetermined instants of transmission, [of] at least one coded data element [produced by at least one of said coding steps] of at least one of said series of coded data elements.

3. (Amended) A method according to claim 2, wherein said elimination step consists of [a periodic] periodically

switching among said [coding steps] parallel outputs by which, at each transmission instant, a single coded [symbol] data element is selected from among the distinct series of coded data elements [set of symbols coded by each of said coding steps].

4. (Amended) A method according to claim 1, wherein each of said temporal interleaving steps is followed by a [delay] delaying step,

[said temporal interleaving step taking account of the source data elements in the order in which said source data elements feed a first coding step and restoring them in a different order to feed a second coding step,]

said [delay] delaying step assigning, to each of said source data elements coming from said temporal interleaving step, a delay equal to [the] a time of latency [of decoding of] for coding the data elements coded by said first coding step.

5. (Amended) A method according to claim 1, wherein said temporal interleaving step implements at least one interleaving matrix in which said source data elements are recorded in successive rows [(and columns respectively)] and read in successive rows [(and columns respectively)].

6. (Amended) A method according to claim 5 wherein, at writing, two successive source data are written in [the increment] between two rows [(and columns respectively) and/or at

reading, the] selected according to an increment [between two columns (and rows respectively)] which is strictly greater than 1.

7. (Amended) A method according to claim 6, wherein said increment between two rows [(and columns respectively)] is a function of the position of the column [(or row respectively)] during writing [(or reading respectively)].

<sup>10</sup>/<sub>8</sub>. (Amended) A method for [the] decoding [of] received digital data elements representing source data elements coded according to the coding method of claim 1, wherein said decoding method comprises an iterative decoding procedure comprising the steps of:

- in a first iteration, combining each of said received digital data elements with a predetermined value to form an intermediate data element,

- [a step for the] decoding [an] the intermediate data element representing [a] each received data element[, producing] to produce a [decoding] decoded data element, [and]

- [a step for the estimation of] estimating said [received] source data element, by means of said decoded data element, [producing] to produce an estimated data element,

and [wherein said intermediate data element is obtained, for the first iteration, by a combination of said received data element with a pre[-]determined value, and] for [the following] all subsequent iterations, [by a combination of] combining each of said received data [element] elements with one of said estimated data elements estimated during [the] a preceding [iterations] iteration.

<sup>11</sup>/<sub>8</sub>. (Amended) A method according to claim <sup>10</sup>/<sub>8</sub>, wherein said [estimation] estimating step assigns to said estimated data element an additive noise decorrelated from [the] noise assigned to said received data element.

<sup>12</sup>/<sub>10</sub>. (Amended) A method according to claim <sup>10</sup>/<sub>8</sub>, wherein said predetermined value [is neutral] has a zero weight, having no effect on said decoding, and said combinations are, for iterations other than the first one, summations of said received data element and of the [last] estimated data element estimated in the immediately preceding iteration.

<sup>13</sup>/<sub>11</sub>. (Amended) A method according to claim <sup>10</sup>/<sub>8</sub>, [of the type] applied to [the] decoding of data coded according to a method [that carries] carrying out [the] a joint transmission of source data elements and coded redundancy data elements, wherein said decoding step takes account of all the received data elements, source data elements and coded data elements, and



wherein said estimation step is applied solely to the estimation of said source data elements.

<sup>16</sup>  
~~12~~. (Amended) A method according to claim <sup>10</sup>~~8~~ [9], of the type carrying out the decoding of a first and a second series of received data elements representing source data coded according to a coding method implementing two redundant coding steps in parallel, the first coding step carrying out a first redundant coding on all the source data taken in [their] natural order and the second coding step carrying out a second redundant coding on all the source data [elements] taken in an order modified by a temporal interleaving step to produce two distinct series of coded data elements, wherein said decoding method comprises the [following] consecutive steps of:

- first decoding according to said first redundant coding the first series of received data elements taken together with at least one of said intermediate data elements to produce[, as a function of at least one of said intermediate data elements and of at least one coded data element produced by said first coding step, producing] a series of first [coded] decoded data elements [element];

- [temporal] temporally interleaving, identical to said interleaving step of the coding method, [of] said first decoded data elements to form a series of decoded de-interleaved data elements;

- second decoding according to said second redundant coding[, as a function of at least one of] said [first] decoded [and] de-interleaved data elements and [of at least one coded data element produced by said second coding step, producing] the second series of received data elements to produce a series of second [coded] decoded data elements [element];

- [estimation of the received] estimating the source data [element, as a function of] from at least one of said series of first and second decoded data elements[, producing an] to produce a series of estimated data [element] elements; and

- de-interleaving, symmetrical to said interleaving step, [of] said estimated data [element] elements.

<sup>17</sup>  
~~13~~. (Amended) A method according to claim <sup>16</sup>~~12~~, wherein said [estimation] estimating step consists in determining the variable  $[(d_2 \cdot (X_1) - (X_2)) / (d_2 - 1)]$   $(d_2 \cdot (X_1) - (X_2)) / (d_2 - 1)$  where:

-  $d_2$  is the free distance of said second redundant coding;

-  $X_1$  and  $X_2$  are the data elements decoded by said first and second decoding steps.

<sup>21</sup>  
~~18~~. (Amended) A method according to claim <sup>20</sup>~~15~~, wherein said coefficient  $\beta$  [is variable] varies as a function of [the] a signal-to-noise ratio of [the] a transmission channel.

<sup>19</sup>  
17. (Amended) A method according to claim <sup>16</sup>12, wherein

*A* <sup>2</sup> said first decoding step is followed by a step [for the subtraction] of subtracting, from said first decoded data element, [of] said estimated data element.

20. (Amended) A decoding module carrying out an iteration of [the] a decoding procedure [of the decoding method of claims 9,] comprising at least two inputs, corresponding to at least one received data element and to at least one estimated data element, and at least two outputs corresponding to at least one decoded data element and to at least one estimated data element,

*A3* wherein said module is capable of being cascaded with at least one other identical module.

*sub B* 21. (Amended) A module according to claim 20[, of the type implementing the decoding method according to claim 12, wherein said module comprises] comprising:

- means for [the] summation of the inputs corresponding to said received data element and to said estimated data element;
- first decoding means for [the] decoding of data elements coded according to a first redundant coding, taking account of the data elements coming from said summation means;
- first interleaving means for [the] interleaving [of] the data elements coming from said first decoding means;

- second decoding means for [the] decoding [of] data coded according [to] to a second redundant coding;
- means for [the estimation of] estimating said received data element or elements;
- first de-interleaving means for [the] de-interleaving [of] the data elements coming from said estimation means;
- second de-interleaving means for [the] de-interleaving [of] the data elements coming from said second decoding means, delivering the data elements decoded in their original order; and
- delay means designed to compensate for [the] latencies of the decoding means, interlacing means and de-interlacing means so that all the data elements coming from said module correspond to one and the same instant of reception.

Please add claims 23 and 24 as follows:

-- <sup>8</sup>23. A method according to claim 5 wherein, at reading, two successive source data are read in two columns selected according to an increment which is strictly greater than 1.--

-- <sup>8</sup>24. A method according to claim <sup>8</sup>23, wherein said increment between two columns is a function of the position of the row during reading.--

Remarks

In response to the Official Action of February 8, 1994, the applicant has made certain changes to the specification to

correct observed typographical errors and/or ambiguities. Similarly, certain changes have been made to the claims as suggested by the Examiner and to points otherwise observed which should eliminate any indefiniteness in the claims and overcome the Examiner's rejection under 35 U.S.C. § 112. The applicant notes the need for a formal drawing for FIG. 4 which will be submitted when indication of allowability of the application is received.

The applicant has amended claim 20 to stand in independent form. Claim 22 has been cancelled, while new claims 23 and 24 have been added to the application. The claims, as amended, highlight various features of the invention which relates generally to a new method or structure of error correction coding based on the use of at least two systematic convolutional codings in parallel, with all of the convolutional codings applied to the entirety of the source data element sequence, and with at least one of the two convolutional codings occurring subsequent to an interleaving of the source data element sequence. In other words, two independent codings take place. These codings are fed by the same data elements, however, the order of feeding of the data elements to the two coders are different. Claims 8-19, 23 and 24 focus on a method for decoding received data elements representing source data which has been coded in accordance with this general scheme, while claims 20 and 21 are addressed to an apparatus for performing the claimed

methods. All of the claims are believed to be patentable over the prior art.

Betts, U.S. Patent No. 4,677,626, discloses a self-synchronizing interleaver for trellis encoder using a single classical encoder 20 which includes long delay units 22, 24 and 26. While Betts does disclose the use of multiple trellis decoders 56, 58, 60 and 62, the trellis decoders are used only one at a time (column 3, lines 57-60). Thus, the data fed to any single trellis decoder is necessarily not fed to any of the other trellis decoders. There is no suggestion in Betts that the trellis decoders should be used in parallel. There is further no suggestion that there should be parallel convolutional encoders 20, both of which are fed with all of the source data but taken in distinct order as required by the claims of the present application. Additionally, there is no suggestion in Betts that data is to be interleaved between the two coders to process two distinct series of data elements originating with the source data.

The Piper document discloses a particular method for interleaving data elements and, in fact, the method disclosed in Piper can be used for carrying out the interleaving process of the present invention as disclosed on page 15, lines 5-12, of the present specification. Piper, however, does not suggest the elements which are missing from Betts. There is no suggestion in Piper of the parallel convolutional coding of two sets of data including all of the data elements of a common source, but taken

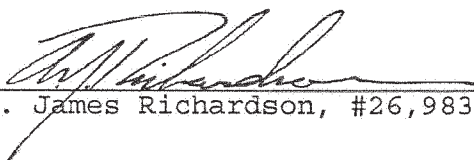


in a different order. Further, there is no suggestion in Piper which would aid Betts in suggesting any of the claimed methods for decoding the data once encoded in accordance with the present application.

Applicant therefore submits the claimed invention is patentable over the art of record and requests reexamination and reconsideration of the application as amended.

Respectfully submitted,

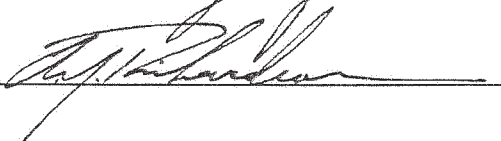
**Locke Reynolds Boyd & Weisell**

By:   
A. James Richardson, #26,983

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I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail, Postage Prepaid, in an envelope addressed to: Hon. Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, Washington, D.C. 20231, this 22<sup>nd</sup> day of July, 1994.



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